

### **3. MAINTENANCE AND REPAIR PROGRAM**

#### **3.1. GENERAL**

The material integrity of any high-pressure system shall be maintained through a program of regular maintenance, documented repairs, inservice inspections and planned facility upgrades. This chapter outlines the facets of the maintenance and repair programs that work together to maintain pressure system integrity.

#### **3.2. PREVENTIVE MAINTENANCE (PM)**

The Computerized Maintenance Management System (CMMS) is managed by the Zone Maintenance Section, Systems Engineering Competency (SEC). The preventive maintenance program shall consist of numerous maintenance checks that periodically occur on a particular system. Specific entries into this computerized maintenance system shall be the result of manufacturer's suggested maintenance, facility engineering recommendation, or by FC request. The FESS COTR shall ensure the FESS Contractor performs the periodic maintenance in accordance with the CMMS schedule and reports completed actions to the appropriate FC and the SEC.

The most important safety devices on any pressurized system are the safety devices provided for overpressure protection of that system. These are devices such as safety valves, safety relief valves, rupture disks, or other non-reclosing devices that are called upon to operate and reduce an overpressure condition. The FESS COTR shall ensure operational testing of these safety devices is conducted by the FESS contractor based on the periodicity denoted in the CMMS. Once these safety devices have completed satisfactory testing, they shall be tag (see Appendix A) and return them to service.

#### **3.3. REPAIRS**

Repairs to correct material deficiencies shall be documented using the same CMMS that records the preventative maintenance program. However, in the event that a repair modifies a high-pressure system, a CNS shall be submitted in accordance with LAPG 1740.4, "Facility System Safety Analysis and Configuration Management." In this fashion, Configuration Management (CM) shall be maintained.

#### **3.4. PLANNED SYSTEM MODIFICATIONS**

From time to time it shall be necessary to upgrade or modify existing high-pressure facilities. Again, as noted in LAPG 1740.4, "Facility System Safety Analysis and Configuration Management," modifications that affect configuration controlled systems must be documented. A CNS shall be completed and submitted. Through the CNS process, the R&CM Contractor is made aware of impending modifications to existing pressure systems or vessels. This allows the R&CM Contractor to be prepared to update the pressure system database, PSD, and the permanent record file respectively in order to maintain an up-to-date permanent record file and pressure systems database.

### **3.5. INTERFACE WITH PRESSURE SYSTEM DATABASE**

As noted in Chapter 2, the permanent record file shall be the repository of all changes that have occurred to the pressure system or vessel. The key form that shall trigger all the document changes and alerts the R&CM Contractor to impending modifications shall be the CNS. Once the CNS form comes to the R&CM Contractor, it shall alert them to imminent pressure system modifications. This allows the R&CM Contractor to interface with the PSM and determine the most logical time to schedule a field survey and update the pressure system database regarding the respective vessel/system.

## **4. OPERATIONS**

### **4.1. GENERAL**

Operating procedures and operational logs are critical to the operation of pressure vessels/systems. Operational records/logs shall provide a continuous chronological narrative of the facility operation and shall provide a history of service being conducted (continuous, intermittent, or irregular). Additionally, these types of logs shall be used in determining trends in system performance, cyclic information, and material issues. Issues, incidents, and mishaps that warrant further investigation shall be submitted in the format of an accident/incident report.

### **4.2. OPERATING PROCEDURES/CHECKLISTS**

Standard Operating Procedures (SOPs) are essential to the safe operation of any pressure system and shall be developed as specified in LAPG 1740.4, "Facility System Safety Analysis and Configuration Management." Additionally, checklists may be developed using the same process as the SOP covering a particular segment of the systems operation.

### **4.3. OPERATIONAL RECORDS/LOGS**

Within any particular facility, based on the judgment of the FSH and/or FC, a continuous log of operations shall be maintained. This log shall denote:

- The type of test being conducted,
- The date/time/duration of the test,
- Any items that might have caused delays (e.g. status lights not operating, communication difficulties, clogged filters, filling of tanks, model problems and test equipment failures), and
- Significant items of interest (e.g. car crash, power outage, environmental problems (storm, lightning, snow), acute illness of person(s) and fire).

Based on the operational complexity and/or material requirements, records pertaining to specific component or system operation shall be recorded by operators and retained at the facility. Information recorded in these records shall pertain, as a minimum, to temperature, pressure, fluid levels and component status. These records shall be stored chronologically at the facility and shall be used by the PSM in record reviews conducted before recertification. The FSH shall coordinate with the PSM to determine if recording specific information shall be required for maintaining system integrity and future recertification.

### **4.4. ACCIDENTS/INCIDENTS**

As defined in LAPG 1740.4, "Facility System Safety Analysis and Configuration Management," accidents, mishaps, incidents, and close calls shall be documented as specific circumstances dictate. All completed accident/incident reports shall be filed

with the OSFA. The R&CM COTR shall ensure the R&CM Contractor reviews these incident files periodically to determine if pressure vessels or systems were involved. Copies of such incidents, if noted, shall then be placed in the appropriate permanent record file.

## 5. TRAINING

### 5.1. GENERAL

The introduction of the human element into a perfectly designed and controlled hardware system brings with it a potential for unexpected results. As depicted in statistics compiled by the National Board of Boiler and Pressure Vessel Inspectors, over the past several years anywhere from 15-40% of accidents that have occurred with unfired pressure vessels occurred because of human error. Hence, the only way to minimize the occurrence of “operator error” is using trained, knowledgeable, and qualified operators. The operator must be competent in the high-pressure system’s operating procedures, emergency systems/components, and essential safety devices and limits. Several methods shall be employed to ensure personnel are trained/qualified, both in general pressure vessel/system safety, as well as specific system procedures and limits. This chapter outlines general and specific training requirements for operators and installation personnel.

### 5.2. HIGH-PRESSURE SYSTEM AWARENESS TRAINING

The OSFA shall be responsible to periodically provide to all installation personnel general pressure vessel/system awareness training. This training shall concern itself with the basic hazards and controls that are inherent in high-pressure systems. Specifically, the following subjects shall be covered:

- Definition of high-pressure systems and vessels;
- Overpressurization protection (safety relief devices);
- Relationship of various pressure terms (Maximum Operating Pressure, MAWP, pneumatic test pressure, hydrostatic test pressure, etc.);
- Programs to maintain integrity of systems (PSCM, IIP, preventative maintenance, inherent design safety factor, qualified operators, etc.);
- Review of incidents/accidents that have occurred (either at LaRC or at other NASA and non-NASA facilities as appropriate);
- Demonstrative illustrations of the potential power that pressurized vessels/systems contain;
- Necessity for procedural accuracy and compliance;
- Personnel/committee roles such as PSM, SPE, PM, PSC; and
- Necessity to conduct only approved modifications to any high-pressure system or vessel.

This training shall be conducted by OSFA either on-site, using the in-house television system or with posted E-mail reminders to be used at employee safety meetings. Each facility’s FSH shall be responsible for attendance and informing the OSFA of compliance.

### **5.3. HIGH-PRESSURE SYSTEM OPERATOR TRAINING**

Pressure system operators/handlers shall be qualified/certified as required by NPG 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems." Qualified equipment operators shall be certified by line management, as required by LAPG 1710.40, "Safety Regulations Covering Pressurized Systems." The FSH/FC coordinate shall ensure that all equipment operators possess the requisite qualifications in the equipment/system to be operated. This specific training shall include:

- Overview of system design;
- Interrelationship of system components such as valves, control systems, safety devices, interlocks and monitoring equipment;
- Instruction in procedures for specific jobs;
- Alarm conditions (visual and audible) and required emergency action/operation;
- Specific instruction on handling of potentially dangerous fluid or gas used in the process;
- Review of incident and accident reports and the recommendations to prevent reoccurrence;
- Review of recent equipment failures and repairs;
- Review of any changes in system operation and procedures; and
- Review of system notes, cautions, and warnings.

Along with the list of certified operators, records of training shall be kept by the FSH and shall include date, areas discussed, copies of any handouts or lesson plans, and attendance sheets.

### **5.4. INSPECTOR TRAINING**

All NDE of pressure vessels/systems shall be conducted by personnel who are qualified in accordance with American Society for Nondestructive Testing (ASNT) SNT-TC-1A. Additionally, all radiographs shall be reviewed/approved by government inspectors qualified as ASNT level II inspectors. All other acceptance testing of newly installed high-pressure system piping shall be performed by inspectors qualified as either Certified Welding Inspectors or Certified Assistant Welding Inspectors in accordance with American Welding Society (AWS) - D.1.1.

**Continue to Next Section**